NCERT Solutions for Class 12 Biology Chapter 9 – Biotechnology Principles and Processes

9.1

Can you list 10 recombinant proteins which are used in medical practice? Find out where they are used as therapeutics (use the internet).

Ans:

(i) Human insulin – Treatment of Diabetes

(ii) Human growth hormone – curing Dwarfism

(iii)Blood clotting factor Y1H/IX-Hemophilia

(iv) TPA (tissue plasminogen activator) – Prevent Heart attack/strokes

(v) PDGF (platelet derived growth factor) – Stimulates wound healing.

(vi) Interferon – Treatment of viral infection.

(vii) Interlinking – Enhances immune reaction,

(viii) Hepatitis B vaccine – Prevention infectious disease.

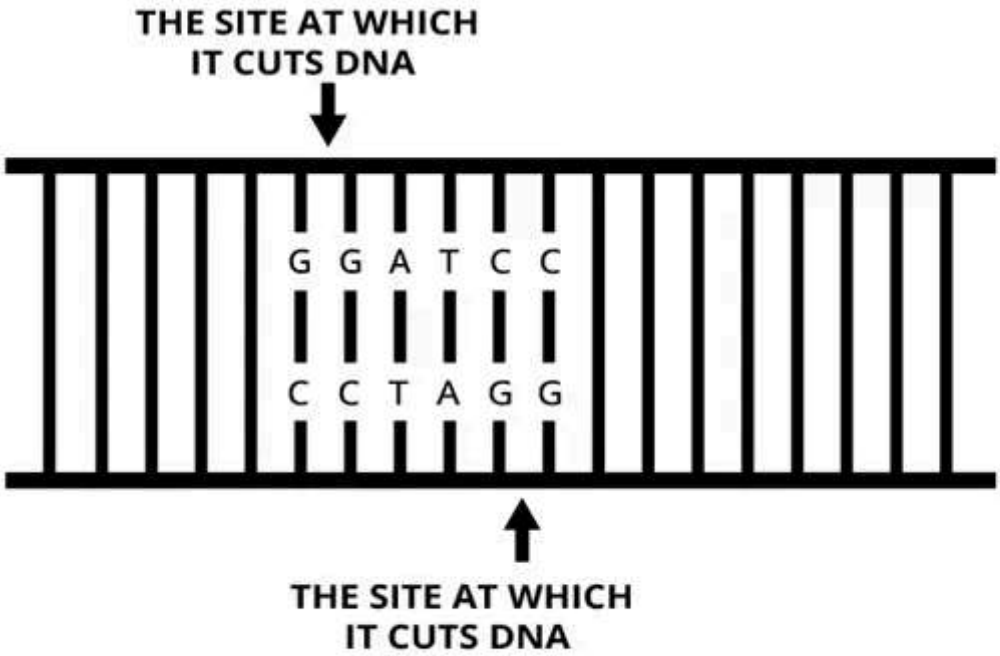
(ix) Herpes Vaccine – Prevention of infectious disease.

(x) DNase I – Treatment of cystic fibrosis.

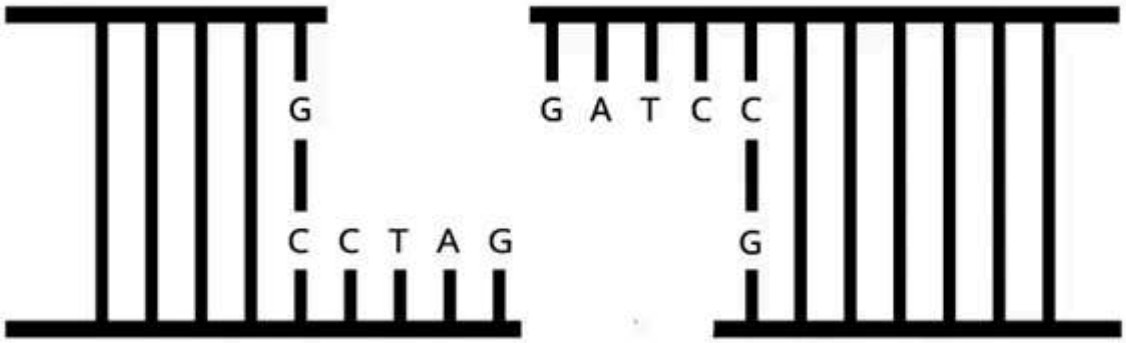
9.2

Make a chart (with diagrammatic representation) showing a restriction enzyme, the substrate DNA on which it acts, the site at which it cuts DNA and the product it produces.

Ans:



The products it produces :



9.3

From what you have learnt, can you tell whether enzymes are bigger or DNA is bigger in molecular size? How did you know?

Ans: Because protein molecules are made up of amino acids, which are shorter compared to nucleotides, enzymes such as proteins are more frequently encountered than DNA. A length of polypeptide chain transforms into a protein shortly after having undergone specific changes. A metabolic enzyme is a protein whose synthesis is regulated by a gene. A codon is a sequence of 3 nucleotide bases that assist in the coding of an amino acid, subsequently polymerized to generate a polypeptide chain and, following specific changes, turns into a molecule of protein.

9.4

What would be the molar concentration of human DNA in a human cell? Consult your teacher.

Ans: Human cells contain DNA at a molar concentration of 2 mg/ml.

9.5

Do eukaryotic cells have restriction endonucleases? Justify your answer.

Ans: The answer is no, as the restriction endonucleases are absent from eukaryotic cells. This is the case because a modifying protein called methylase heavily methylates the DNA of eukaryotes. Cellular methylation shields the DNA against enzyme-induced restriction action. Prokaryotic cells possess enzymes that prevent viruses from infecting their DNA. Each inhibition endonuclease has been isolated from different bacterial varieties. The above enzyme represents a defense system found in bacteria or prokaryotic cells that prevents bacteriophage development, such as HindIII & EcoRI.

9.6

Besides better aeration and mixing properties, what other advantages do stirred tank bioreactors have over shake flasks?

Ans: Shake containers are frequently used in research facilities for small-scale substance blending & development. Large-scale production of biotechnological goods is possible with biological processors. Bioreactors offer several additional benefits besides improved oxygenation & stirring capabilities.

(i) A tiny quantity of cultures is regularly taken from the bioreactor.

(ii) The pH control framework, which maintains the fluid's pH throughout the whole procedure, and froth are used in the foaming breaking mechanism as control devices.

(iii) The bioreactor can manage a consistent mixture & supply of oxygen through bottlenecks.

9.7

Collect 5 examples of palindromic DNA sequences by consulting your teacher. Better try to create a palindromic sequence by following base-pair rules.

Ans: The nucleotide sequences in the DNA molecule are palindromes, meaning they are the same whether they are read 5′-3′ or 3′-5′. At these sites, restriction enzymes act.

Here are five examples of palindromic DNA sequences:

i. 5′ GGATCC 3′ ———3′ CCTAGG 5′ ———

ii. 5′ AAGCTT 3′ ———3′ TTCGAA 5′ ———
iii. 5′ACGCGT 3′ ———3′ TGCGGA 5′——— 5′ ACGCGT 3′ ——— 3′——— TGCGCA 5′
iv. 5′ ACTAGT 3′ ——— 3′ TGATCA 5′ ———
v. 5′ AGGCCT 3′ ——— 3′ TCCGGA 5′ ———

9.8

Can you recall meiosis and indicate at what stage a recombinant DNA is made?

Ans: Meiosis I takes place in Prophase I, characterized by the formation of recombination nodules following the establishment of synaptonemal complexes.

9.9

Can you think and answer how a reporter enzyme can be used to monitor transformation of host cells by foreign DNA in addition to a selectable marker?

Ans: Researchers can bind a regulatory protein or a gene that interests them in any cell culture to activate a reporter genetic material, also known as a reporter enzyme. They have the task of quantifying the functioning of genes. A gene that is inserted into the genetic code of a cell to give an attribute appropriate for deliberate selection is known as a selectable marker. By identifying its co-response genetic material (receptor gene) within the action of a reporter enzyme, cell transformation can be accurately distinguished. In particular, altered cells look white because they lack the (3-galactosidase (Lac Z) enzyme. Blue ones appear to be devoid of alien DNA. Therefore, in addition to being a selective marker, reporter digestive enzymes may additionally be employed to track how foreign DNA is transforming cells that it invades.

9.10

Describe briefly the following:

(a) Origin of replication

(b) Bioreactors

(c) Downstream processing

Ans: (a) Every fragment of DNA connected to a particular pattern in the human genome can cause multiplication in the host organism because this pattern is where duplication starts. The entire sequence and the process for regulating its copy amount are both present in the connected genetic material (DNA). Therefore, a vector that originates from permits replicating

more than one copy should be used to replicate DNA coming from an intended target in several instances.

(b) The digestive enzymes of plants, animals, and microorganisms can transform fundamental nutrients into specific goods using a biological reactor. The ideal conditions for growth and intended results are employed in a bioreactor. Stirring-type biological reactors were the most often used. To enhance combining, mixed tank biological reactors are cylindrical tanks featuring curved bases. Supply the hygienic air to the living organisms under the stirred reservoir-based bioreactor for clean bubbles of air. The stirrer facilitates the bioreactor's churning and aeration. A biological reactor comprises various components, including an agitator structure, an oxygen distribution system, a foaming management system, a temperature control device, and a pH regulation system.

(c) Until a commodity is prepared for promotional activities, it goes through multiple steps. Among the primary purposes are segregation and filtration. The finished product is then infused with stabilizers. Like medications, these supplements must go through clinical testing.

9.11

Explain briefly

(a) PCR

(b) Restriction enzymes and DNA

(c) Chitinase

Ans: (a) An experimental in vitro molecular science technique called the polymerase chain reaction (PCR). It blends the enzymatic multiplication of a single strand of DNA, creating millions of clones using a specific DNA genetic material within 2 hours. Three stages are needed to make up PCR:

(i) The double-stranded DNA is denatured to single-stranded DNA @ 96°C.

(ii) Based on the annealing method, the primer gets converted to ssDNA (single-stranded) around 55–65°C.

(iii) At 72°C, the enzyme known as Taq DNA polymerase, which was extracted from Thermus aquaticus, created fresh DNA strands.

The target genetic material is cloned using an enhanced genome. It has contributed to increased effectiveness and production, decreased vulnerability to shortcomings, and fewer computerized and repetitive errors made by humans.

(b) For enzymes with restriction to cut the DNA molecule, they must first break a particular base pattern called the recognition region.

(i) Breaking foreign DNA via various identification methods can stop the material from entering healthy cells. Recognition spots are palindromic.

(ii) There are both exonucleases & endonucleases.

(iii) Their extremities are slippery. The separation site and the spot where recognition occurs are not the same thing. Thus, it's believed that bacteria's production of restriction enzymes acts as a form of resistance to viral infections. It also eliminates viral DNA sequences, which hinder the bacteria's capacity to survive.

(c) The family of enzymatic processes known as chitinases is broad and varied. It has a unique molecular makeup, substrate characteristics, and catalytic processes. To aid in processing or conversion, the enzyme known as chitinase dissolves the glycosidic bonds in chitin. It's found in fungi, including the outermost layer of some arthropods & parasitic worms. Chitinases are employed as a therapeutic component in body & hair care in manufacturing medications due to their biological roles. These chitinases may be employed to fight off fungi that thrive in conditions that are dry & hot.

9.12

Discuss with your teacher and find out how to distinguish between

(a) Plasmid DNA and Chromosomal DNA

(b) RNA and DNA

(c) Exonuclease and Endonuclease

(a)

Plasmid DNA	**Chromosomal DNA**
1. Self-reproducing	Nuclear controlled replicas
2. Double stranded in a circular fashion	It can be linear, circular, or double stranded
3. Don't get connected to histones	Histones are linked to specific protein molecules.
4. Comprises a small amount of genetic material for traits including fertility component & resistance to antibiotics.	Regulates protein composition and characteristics of cells to regulate their rate of metabolism.

(b)

RNA	DNA
1. Ribose – a type of pentose sugar, combined with a substance called ribonucleic acid	Deoxyribose comprises a kind of sugar that comes from deoxyribonucleic acid
2. Single stranded structure	Double stranded structure
3. Transfer of data between DNA and protein molecules	The genetic components of the human anatomy
4. Incorporates the bases of pyrimidines, uracil & cytosine	Pyrimidine compounds are bases that consist of thymine & cytosine
5. The existence of the 2′-OH group in nucleotides made from RNA reduces longevity	Due to the double-stranded structure & thymine, it becomes more robust
6. The enzyme RNA polymerase is in charge of production	The DNA polymerase byproduct

(c)

Exonuclease	Endonuclease
1. Take the nucleotides that come out of the DNA's terminals	Remove nucleotides from particular DNA locations
2. Make ends that are blunt	Produces endings that are sticky
3. There are no barriers preventing pathogens from penetrating	Prevent the movement of pathogens from entering